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DEVELOPMENT POSSIBILITIES FOR SMALL-SCALE INDUSTRY IN SPECIFIC FIELDS OF INDUSTRIAL ACTIVITY

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DEVELOPMENT POSSIBILITIES FOR SMALL-SCALE INDUSTRY IN SPECIFIC FIELDS OF INDUSTRIAL ACTIVITY

INTRODUCTION

1. Functional Characteristics of Small-scale Industry

In the domain of industrial activity, there are wide differences between enterprises, even between those in the same field, in the number of persons employed, the capital investment, the level of mechanization and the organizational structure. For convenience, or for legal purposes, enterprises are classified as "large", "medium" or "small" with reference to an arbitrarily selected parameter, usually the number of employees per establishment, sometimes investment in fixed capital, and sometimes both. The boundaries of the categories are always indistinct. They vary from country to country, within the same country, and even from trade to trade. Until recently, in India an undertaking using mechanical power and employing not more than 50 persons, or 100 persons if there is no power, was regarded as a small-scale establishment; some years ago, the employment ceiling was abandoned and the definition now covers all manufacturing enterprises with an investment in capital of not more than 500,000 rupees (about US $66,666), except ancillary enterprises for which the capital ceiling is 1,000,000 rupees ($133,332). The employment ceiling in Japan is 300. The Small Business Administration in the United States classifies a business as small if it has less than 250 employees, and if within the range 250 to 1,000 it may be either small or large depending on the industry to which it belongs. These limits have been set with the object of defining the scope of governmental assistance.

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Where numerical indices are attached to the classifications large, medium and small they tend to disguise the essential similarity of establishments on both sides of the dividing lines. There is some logic in regarding industry as being made up of large and small enterprises, and to distinguish between the two - as suggested by Eugene Staley [1] - by their functional characteristics. While there are exceptions, the distinguishing features of small-scale industry in the developing countries are:

(a) Very little specialization, or none, in management functions;

(b) Shortage of capital, and only very limited access to institutional finance;

(c) Weak bargaining position in its markets;

(d) Close personal contact between management and workers, and often between the firm and its customers;

To these Staley adds "a relatively close integration with the local community through local ownership and management and dependence on nearby markets and sources of supply". He suggests that the possession of several, say two or more, of these characteristics places an establishment in the small-scale category. Features (a) and (b) may be the more prevalent, the others being either consequential or incidental.

Associated with the foregoing may be:

(e) The employment of obsolete technological processes;

(f) The preference for the production of traditional lines; and

(g) A reluctance to introduce innovations.

The latter group may be exhibited in varying degrees or may be absent altogether. In any case, it is necessary to consider these in relation to the general level of technology in the territory.

There are thus, according to this view-point, two extreme types of small-scale industrial undertakings. One in which only the first group of characteristics, perhaps only (a) and (b), is present, and another in which all of the features are represented. Between these there are many intermediate types.

1/ E. Staley, Small Industry Development, Stanford Research Institute (Menlo Park, California), Research Program on Small Industry Development, Miscellaneous Paper No. 1, December 1958. See also Modern Small Industry for Developing Countries, by E. Staley and R. Morse, McGraw Hill, New York, 1965.

A useful distinction is that between industries employing modern technological processes, and those clinging to obsolete practices. The latter have grown, directly or indirectly, form artisan workshops or handicraft establishments, and still tend to produce the type of articles needed in an unsophisticated community. They are relics of the pre-industrial era, and may be described as the "traditional" type of small-scale enterprise. Opposed to these are the "modern" small-scale undertakings, which may have come into being in their present form, or may have the same origins as the traditional type, but at some point in their process of growth made a break with the past by introducing new and technologically more advanced methods, accompanied, very often, by diversification of production.

In all but the most isolated communities, the traditional type of enterprise tends to disappear. It is unable to counter the competition from modern undertakings in terms of price and variety and, in some cases, of quality. There are, of course, exceptions; particularly in relation to goods of an artistic nature (special woven materials, non-utilitarian ceramics) and specialized foods (farine). Whether the products of the traditional undertaking are replaced by those of a large or small-scale modern factory will depend on a number of factors; the size and sophistication of the market, the effectiveness of the distribution system, the extent of the raw materials available, and the policy of government in relation to decentralization and protection. Even in the field of food processing, where personal taste and local custom may play a significant part, this trend is evident. A classic example is the gradual disappearance of the small local bakery.

The objective of economic development is to raise the level of living. This is not a stationary target, as with each improvement the objective standard increases. Progress in the desired direction can be made only if the most effective use, consistent with the current levels of technology and infrastructure, is made of the available resources - capital, skills, materials and power. The emphasis is on most effective use. This phrase cannot be equated to efficiency in the narrow technical sense; by it is to be understood the optimum use of all the varied factors that affect production. In certain circumstances this may involve a compromise with technical efficiency. In the same field, large-scale undertakings often, but by no means invariably, are technically more efficient than their smaller counterparts.

That is not to say that they make more effective use of their inputs. To replace a manual by a mechanized operation, for instance, is not effective use of capital if the machine cannot be kept employed for a reasonably large proportion of its useful life. As effective users of resources large and small-scale enterprises have their places. In the small-scale sector, however, the traditional types do not, as a rule, make the best use of their available resources. Their replacement by, or transformation into, the modern small-scale undertaking is a necessary step on the road to industrialization, and to the living standards that only industrialization can bring.

It is not uncommon to hear the opinion expressed that small-scale industry is a transitional phase in the industrial evolution of a country; that in highly industrialized countries the manufacturing industry is composed entirely of large undertakings; and that only such establishments can take advantage of modern technological methods. Omitting, for the moment, the last contention; if there is any substance in the others, one would expect statistics to show, over a number of years, a decrease in the ratio of small to large-scale enterprises in industrializing countries, and a significantly lower proportion of small-scale establishments in the highly industrialized territories. It will be seen in Table I that the ratio of small to large-scale establishments tends, if anything, to increase, and that the proportions of small-scale enterprises are remarkably alike in both industrializing and industrialized countries.

Table I. Small Industrial Establishments in Selected Countries 1920, 1935 and 1950[a]

	Establishments employing 11 to 50 persons as a percentage of all establishments with a staff of 11 or more			Employees in establishments employing 11 to 50 persons as a percentage of all employees in establishments with a staff of 11 or more		
	About 1920	About 1935	About 1950	About 1920	About 1935	About 1950
Argentina[b]	-	76	78	-	27	29
Belgium[c]	76	74	76	27	24	26
Brazil[d]	74	77	-	20	24	-
Canada[e]	75	78	79	25	25	21
France[f]	77	77	-	28	27	-
Japan[g]	81	81	87	30	29	38
Sweden[h]	68	74	75	22	24	25
Switzerland	71	72	75	26	26	27

Source: "The Size of Industrial Establishments", in International Labour Review (International Labour Organisation, Geneva), Vol. LXIII, No. 6, June 1965, page 640.

a/ Manufacturing industries except where otherwise stated.
b/ Number of wage earners.
c/ Ten or more wage earners excluding members of employer's family.
d/ Wage earners in 1920.
e/ Establishements with 5 - 50 employees (5 - 49 in 1949), as percentages of establishments with 5 or more employees.
f/ Including construction.
g/ Wage earners in 1921 and 1935.
h/ Including quarrying and metal mining.

In the highly industrial countries, the United Kingdom, the Federal Republic of Germany, the United States and Japan, the position, as shown in Table 2 with due allowance for the change of base, is much the same as that in the countries listed in Table 1.

Table 2. Role of Manufacturing Establishments Having Fewer than 100 Employees in Selected Countries

Country	Year	Percentage of all manufacturing establishments	Percentage of all manufacturing employees	Percentage of all manufacturing output
United Kingdom	1954	95	23	n.a.
Fed.Rep.of Germany	1950	89	27	23
United States	1954	91	26	22
Japan	1952	99	59	37

Source: Eugene Staley, Small Industry Development, Stanford Research Institute (Menlo Park, California), Research Program on Small Industry Development, Miscell. Paper No.1, December 1958.

It may be concluded from the foregoing that in all countries the small-scale sector is, in terms of number of enterprises, the largest group in the manufacturing industries, and there is no evidence that it is losing its importance in this respect.

To consider modern technology as being applicable only to large undertakings is to ignore factor prices, and to regard all such processes as being large and indivisible. The economies of scale are only fully realized when the indivisible factors of production are combined in optimum proportions. For the lowest cost of production the most advanced technology may not be the best "for there are at all times a long string of mechanical devices known to the engineer which appear to have everyting in their favour except that they would not pay." 2/ There are some operations that require large and expensive units of equipment. Such operations, or processes, are indivisible in the sense that at less than a certain minimum output they would not be profitable. A blast furnace for the smelting of iron ore is such a unit. The investment and labour required

2/ J. Jewkes, "The Size of the Factory", Economic Journal (London) June 1952.

place the operation outside the limit, by any definition, of small-scale industry. On the other hand in many large establishments the operations are performed on a battery of identical machines. In these circumstances the process is divisible, and could be carried out equally well in a small-scale undertaking. The making of cutlery and letter-press printing are good examples of industries where size is a matter of multiplication. As is to be expected, small-scale enterprises are well represented in these fields.

There is a general trend in industrialized countries for establishments to increase in size. In plants employing less than 100 workers, the average employment per establishment was in Italy (1954) and Japan (1951), respectively, 5 and 7. While in the United States (1947) and the United Kingdom (1956) the equivalent figures were, respectively, 17 and 38. It would appear that the longer the history of industrialization the greater the average size of small-scale undertakings. Some small-scale enterprises may outgrow the classification, and others, no doubt, are forced out of business. These factors tend to diminish the relative importance of the small-scale sector as a provider of employment. However, the persistence, over three decades of approximately the same ratios of numerical strength and employment between large and small-scale establishments suggests that, however many undertakings graduate out of the small-scale class or fall by the wayside, there are new opportunities which this sector is able to seize.

The correlation in Table 2 between the percentages of total employment and total production attributable to small scale industry will be observed. While it cannot be denied that, in every country, the average productivity, as measured by the value of production per worker, is lower in the small-scale sector than in the large, the difference is not so great as the exponents of "bid business" would have us believe. A point that is not often taken into consideration in relation to productivity is that while sophisticated machines continue to displace direct labour, it requires a disproportionally large staff to ensure that they are kept in production. To every hundred operatives in Britain in 1924 there were 11.8 employed in administrative, technical and clerical duties, in 1935 the figure was 15.1, and by 1948 it had reached 20.[3/]

3/ P. Sargant Florence, "The Logic of British and American Industry", Routledge and Kegan Paul, London, 1953.

The conclusion to be drawn from the foregoing is: "If small-scale industry appears, broadly speaking, to maintain its relative importance in national economies as economic growth proceeds, it does so not through sheer inertia, but through a process of adaption - of evolution and natural selection. To a large extent the process of adaption that is required would seem to be a process of shifting the centre of gravity of small-scale industry from activities that compete with large-scale industry to activities that are complementary to it." 4/ For far too long small-scale industry to most people has been synonymous with backyard enterprise. By the level of employment it provides and by its contribution to the national product, it is a potent factor in all national economies. It should be recognized as such.

2. The Role of Small-scale Industry in Developed and Developing Economies

In the foregoing paragraphs it has been shown that small and large establishments can, and do, exist side by side. This co-existence does not, of course, pervade the entire industrial field. There is an area which is the exclusive domain of the large undertaking, just as there is a section in which the small-scale establishments form the dominant group. Between these two extremes is a region where large and small-scale enterprises are in competition. In both developed and developing economies there are certain common features in the respective parts that small-scale industry has to play, but there is often a difference in the emphasis which must be placed on them.

In most countries, particularly in developing territories, there are concentrations of population which are widely dispersed. These densely populated areas form the principal markets for the products of industry. It may be found that the savings resulting from large-scale production in any one of them are diminished, or completely lost, by the high cost of transport to the markets in the other centres. This applies particularly

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4/ Services for Small-scale Industry, (I.L.O. Geneva), 1961, pages 18-19.

to perishable and low-value, high-freight goods. For that reason a large concern may establish a small-scale production unit in an area remote from the centre of gravity of population to cater to the local market.

There is a tendency, at the present time, among very large undertakings to decentralize part of their activities. It is no longer believed that all the varied operations that go to make up a complex product must be performed under one roof. There are valid reasons for this; land values usually are lower away from urban districts; there may be more, and possibly cheaper, labour available; and less social unrest. A firm may decide to process its raw material at its source rather than ship it to the central factory. Another may consider that the jigs and tools used in production could be made equally well and at less cost in a small branch factory. The units that are set up, for the reasons given in the two preceding paragraphs, although small in terms of the numbers employed will have some, or all, of the advantages of specializ management on account of their integration with their parent companies.

The circumstances that permit the proliferation of branch factories and subsidiary production units are equally effective in promoting the growth and development of small-scale independent units. In the countries that are now highly industrialized, it was the custom, before mechanical power was generally used, to contract out work to artisans to be done in their own homes. This practice ceased when steam power was introduced as only the large operator could afford to instal it. The advent of electrical power and the ease with which it could be distributed altered the situation. The complexity and scale of modern production processes makes a return to production in the home quite inadvisable, but the part that was formerly played by the household worker can now be carried out by small-scale undertakings. Some countries that were undergoing industrial transformation were not slow to take advantage of the new position. Indeed, in the highly industrialized countries where the majority of the industries at that time, were vertically integrated the possibilities of the situation were less evident. However, it is now recognized that one of the most promising fields for small-scale enterprises is in supplying the

needs of large-scale undertakings. An idea of the extent of the co-operation between large and small-scale industry in Japan is given in Table 5.

Table 5. Selected Data on Subcontracting in Japan

Industry	Dependency on small-scale enterprise as a percentage of total cost of finished product
Rolling stock	70
Shipbuilding	70
Motor cars	62
Textile machinery	54
Telephone switchboards	26

Source: Report of Study Group of Small-scale Industry Experts on their Visit to Japan, United Nations document E/CN.11/I and T/108, 1 February 1955 (mimeographed).

The existence of small-scale establishments is not to be attributed solely to their ability to supply and or complement large-scale undertakings. The needs of every community are not alike, and in any one community the needs at different levels of society are not the same. Many of these needs cannot be met by the mass producers. In the provision of services directly to customers; where the demand is for a wide variety of product; and where long production runs are impossible the small-scale enterprise is the better adjusted.

It is obviously impossible to operate a large-scale undertaking unless the appropriate quantities of raw or intermediate materials, as the case may be, are readily and continuously available. It is undisputed that the sources of such materials are by no means uniformly distributed. Where local sources are sparse the enterprises depending on them, of necessity, must be small. It is true that deficiencies may be made good by importation, but this is not always possible. There are many instances, particularly in relation to the processing of agricultural materials, where the quantities arising in any one location are relatively small and must be treated so soon after collection that central, large-scale processing is impossible. It is true to say that many local resources, not only agricultural, but mineral and sylvicultural as well, would not be exploited but for small-scale industry.

5. The Additional Roles of Small-scale Industry in Developing Territories

In countries undergoing the transformation from an agrarian to an industrial economy, the traditional practice of investing savings in land and valuables still exists. The capital needed to start a small-scale enterprise is seldom too great to be raised by the owner, usually an individual or a small partnership, from personal resources supplemented by loans from friends and relations. In this way the small-scale enterprise can mobilize the wealth frozen in unproductive assets for productive use, and so assist in capital formation.

Agriculture is still the principal activity in the industrializing countries. It is frequently characterized by a dichotomy between plantation and peasant farming. The former is becoming more capital-intensive, and the latter through lack of capital continues to employ obsolete methods with low returns. Furthermore in many areas all, or nearly all, of the available land is under cultivation. Increased yields can be obtained only by better methods, irrigation or improved strains. The consequence is that countries are faced with declining agricultural employment and increasing population. The net result is a decreasing per capita income. The solution to this problem is industrialization. The small-scale enterprise has its part to play in this transformation.

To absorb the redundant agricultural workers industries must be established. It is less costly in social overheads if these industries can be set up in the areas where the unemployed normally reside. The drift to the towns may be lessened. As these areas are rural and, possibly, remote from the centres of high population density, small-scale undertakings are likely to be the only possible type.

There are other roles that small-scale industry may play. The managerial skills required by large-scale industry have to be acquired. The small-scale industry can, and does, provide an excellent training ground for those with the proper enterpreneurial spirit. The experience gained there can be translated into wider fields.

There is frequently in newly industrializing countries a concentration of wealth in the hands of s small minority, and where there is dualism in agrarian territories this condition tends to increase rather than diminish. The existence of small-scale industry has the effect of creating a new

class of small capitalists, leads to the formation of a middle class, and to a wider distribution of income.

The planners of national industrial programmes often fail to consider the possibilities of small-scale industry, and tend to concentrate on large projects. In not a few cases these super-scale undertakings have been costly failures. Some are kept in operation only by government subventions. It is extremely difficult accurately to forecast demands under rapidly changing conditions, and mistakes must occur from time to time. With large-scale establishments mistakes are expensive, and may have the effect of slowing down the progress towards industrialization. That is not the case with small-scale undertakings. Indeed it may be, in countries where capital is scarce, that the only road to a transformed economy is through the small-scale sector.

I. THE INDUSTRIAL FIELDS IN WHICH SMALL-SCALE ENTERPRISES CANNOT COMPETE

Two negative attributes of small-scale industry - lack of capital and specialized managerial skills - have already been noted. It is to be expected, therefore, that the small-scale enterprise will not be represented in those industries which, of necessity, require a heavy capital investment and specialized managerial functions. Both of these criteria call for some amplification. While the capital investment must be great, it must not be so only by reason of the multiplicity of identical unit processes. The indivisible units of production must be physically large, or so interdependent one with another, that the complex virtually is one large individual unit. In many instances the products will be of substantial size and value. Specialized management, of course, is only the division of the various functions, which are carried out, however indifferently, in a small-scale undertaking by one or two persons, among a relatively large number of officials who have expertise in their particular field.

The products listed below require for their manufacture on a commercial scale the employment of large or integrated plant. No small-scale establishment successfully can compete in these lines.

Cement	Textile machinery	Aircraft (assembly)
Heavy chemicals	Marine engines	Shipbuilding (ocean-going)
Heavy electrical machinery	High pressure boilers	Tinplate
Locomotives	Motor vehicles (assembly)	Mineral oil (refining)
Heavy armaments	Iron and steel smelting	Linoleum
Paper machinery	Machine tools (high precision)	Cane sugar (refined)
	Plate glass	

The list is not exhaustive. It is intended only to illustrate the types of product, nearly all of which are either capital goods or intermediate materials. They are produced by the so-called capital goods and intermediate materials are never made in the small-scale sector, it is seldom the case. The exceptions are such materials as lime and rubber, and when capital goods are produced they are usually of relatively low value.

The validity of the statements in the two preceding sub-paragraphs is not affected by the level of industrial development. The plants manufacturing the above items will all be above a certain minimum size, in terms of initial capital investment, irrespective of the country in which they are located. Some, no doubt, grew from small indertakings. If so the growth was not gradual, but by discrete steps with an accompanying change of product. Others, such as those producing cement, tinplate and the like came into being at or above the minimum size.

II. INDUSTRIAL FIELDS IN WHICH SMALL AND LARGE-SCALE ESTABLISHMENTS CAN COMPETE

In most industries, with the exceptions of those manufacturing the products listed in the preceding section, small, medium and large establishments can be found. In the wool and worsted industry in Great Britain, for example, the number of employees in the largest unit is, at least, forty times that in the smallest. Certain factors, locational and economic, operate in such a manner that for most products there is, in broad terms, a prevalent or representative size of plant. In an industrialized country, if small-scale establishments are found in an industry in which the prevalent size is medium or large, and the products are comparable, it is because of its appropriate adjustment to the size of the market it serves, and to the availability of raw materials. In relation to availability of materials the cost of transport

may be an important factor. Articles, nominally the same, produced at different industrial levels may, in fact, differ in quality and design. The garment industry is a case in point. The creations of the famous fashion houses cannot be compared with mass produced clothing. The same applies to the shoe industry. Very often it will be found that the small-scale establishment caters to a specialized market, and there is no competition with the large-scale producer.

In countries undergoing industrialization entire industries may be comparatively small; certain industries may be absent altogether. Under these conditions the prevalent plant size, where there is one, will be small, and enterprises entering any industrial field, except that reserved for the "giants", will also be small. The opportunities for small-scale enterprises will depend on such factors as the size and sophistication of the local market, the possibilities of exporting, the availability of materials either locally arising or imported, the costs of labour and capital, and the degree of protection, if any, provided.

An enterprise cannot survive unless there is a market to absorb its products. Every entrepreneur considering entry into the manufacturing field must make an assessment of the potential market. This is so obviously essential that one hesitates to mention it, but a surprisingly large number fail to do so. It is not an easy task. The published statistics are of only limited assistance as the commodity classifications are, almost invariably, too broad. Advertising, radio and television have educated the public to expect and demand a greater variety of products than hitherto. In a country where the market for a certain category of goods appears to be adequate to support production, this sophistication may mean that the consumption of each individual item within the group is very little, and that the demand can suddenly switch from one line to another. Such a situation is less likely to affect adversely the small than the large producer, as the

organization of the former is more adaptable to change. For example, a retail store may find it necessary to stock forty or fifty different styles of shoes, and its sales of each may be comparatively small. No factory profitably could undertake to manufacture such a range unless it had access to an immense market. Indeed, it has been said that four or five styles are the maximum for optimum production. The demand for one or two styles may be sufficient to absorb the output of a small factory, which can relatively easily change to another style in accordance with the vagaries of the market. In the light engineering field, particularly in connexion with metal pressings, there are many articles that require expensive and specialized appliances for their production, the cost of which must be charged against the goods manufactured. If the price is not to be unreasonably high long production runs are essential. This situation must be faced in those countries in which consumer durables are being assembled from, in the main, imported components. Naturally, such countries are eager to have as many as possible locally made parts incorporated in the assemblies. Many of these, without any difficulty, could be made if the quantities needed were sufficient to allow the equipment to be written off at a reasonably low proportion of the unit price. The automobile assembly industry provides an excellent example of this state of affairs, and in it the situation is not improved by the almost annual changes in design, which have been described as built-in obsolescence. In those countries that have legislation to compel assemblers to use a proportion of locally made parts, the position has been reached where items have to be redesigned so that they can be made with less expensive tools. This does not mean that the local product will be less expensive than the imported equivalent; the reverse is usually the case. The essential decision in selecting articles to be manufactured is not "Can it be made?" but "Can enough be sold to cover the cost of production and leave a reasonable margin for profit?"

The costs of labour and capital usually are the most important items in the price structure of a manufactured article. In developing countries the cost of capital may outweigh the cost of labour, but that is not always the case. In most feasibility studies made for the purpose of selecting suitable products for small-scale industry, one is faced with the problem of balancing the cost of labour against the capital cost of machinery. The cost of labour in some Latin American countries is so high that machinery must be used to replace it, if the product is to be competitive. Very often, it will be found, the break-even production of the mechanized plant is too great for the home market. Unless there are possibilities for export some compromise must be made. Sometimes the only possible solution is protection; a course that may not be in the best interests of the economy as a whole. There is no universal solution to this dilemma. So far as small-scale industry is concerned, a partial answer is to select products that have a relatively high labour content; that do not require to be made on special purpose, high capacity machines; that, in most countries, are made at all industrial levels; and for which there is a healthy local market. In a sense these are alternatives, as it is improbable that an article can be selected that fulfils all criteria. With regard to the means of production, obviously it must be capable of carrying out the intended functions. If a special-purpose machine is essential, there is no alternative. But if the operations may be performed almost as well on a general-purpose machine, it should be chosen.

In certain industries there is no prevalent size of plant. Identical products are manufactured, or services performed, at all industrial levels, the "giants" excected. In such industries the economies of scale are not of great importance. Provided that there is a still unsatisfied portion of the market, the small-scale undertaking can successfully compete with the large-scale manufacturer, and established small-scale concerns will not

find their positions undermined, solely on account of size, by the entry into the field of a large-scale producer. A list of the products of such industries is given below. An attempt has been made to give indications of the capital investment per employee and number of employees in respect of establishments in Trinidad. The writer is indebted to the Industrial Development Corporation of Trinidad and Tobago for this information. Where appropriate data on existing undertakings was unobtainable feasibility studies prepared by various agencies, principally the United States Agency for Industrial Development, (A.I.D.) have been used.

(a) Sugar confectionery. The principal products are boiled sweets and toffees. There is opportunity to use locally arising flavours, essences and fruits. The sweets are machine wrapped. Savings in investment can be made by employing hand wrapping. The product has a good local market, but export is difficult in competition with branded goods. The investment per employee is about U.S. 3,000 (32 employees).

(b) Baking powder. The operation basically is the mixing of refined sodium bicarbonate with sodium pyrophosphate and packaging. The investment varies from 3,200 to 5,200 per worker, the lowest investment per worker being associated with the largest undertaking. Employment ranges from 4 to 20 per establishment.

(c) Biscuits. The size of establishments varies enormously. In Britain the prevalent size is large, but in other countries this is not the case. There is no representative size in the United States. In Japan at least half the national production is from firms employing less than 50 persons. As suitably packed biscuits remain fresh over a long period, and are easily transportable, there is no local advantage for small-scale establishments. The principal ingredients are sugar, flavourings, wheaten flour and shortening. Where wheat flour is imported varying amounts of local flours - soya, arrowroot, cassava - can be incorporated in the dough. The shortening may be

obtained by the hydrogenation of locally produced vegetable oils such as coconut oil. The investment per worker for a plant employing 6 persons is about $4,500. In a highly mechanized factory it may be as high as $15,000 per employee (14 employees).

(d) Pastas. Such items as macaroni, spaghetti, taglione, fanti, noodles and other pastes made from wheat middlings (semolina) are popular foodstuffs in most countries. They have the advantage of keeping fresh almost indefinitely. The investment per worker in a factory with mechanized drying and packing equipment is of the order of $5,000 (25 employees). Some units operate on a very small scale, employing between 1 and 4 persons, usually members of the same family. At this level the products are mee, meehoon or egg noodles, which are sold either loose or wrapped. The equipment may consist of an extruder, often improvised, and a dough roller. The investment is not likely to exceed $500 per worker.

(e) Edible oils. The oils that may be produced will depend on what oil crops can be grown. Sunflower seeds, corn, cotton seeds, peanuts, soyabeans, sesame seeds, copra and the fruits of the oil palm are possible sources of edible oil. Broadly speaking, there are two methods of extraction. The solvent extraction process which is usually employed for soyabean and cotton seed oils, and by expelling or expressing. The former is not an operation for a small-scale undertaking. Next to cottonseed and soyabean oils, coconut oil is commercially the most important. The process of expelling coconut oil is not labour-intensive. Small-scale producers do not usually refine their oil. Their sales outlets are dependent on the quality of the oil. Freshly expressed oil may be sold as a cooking oil, but oils with any degree of rancidity must be sold to refiners or for the making of soap. The large-scale oil millers usually refine and deodorize the oil, and may make it directly into shortenings and soap. The investment per worker in a factory expelling oil and manufacturing soap and shortenings is about $5,000 (200 employees). In a smaller factory the per worker investment in expelling

and refining plant is $10,000 (20 employees). Palm oil is rarely, if ever, made at small-scale level, on account of the high cost of equipment to treat the fruit to prevent rapid rise of the free fatty acid content. Corn oil, which is used almost exclusively as a salad oil, is made from the hulls by expressing. Chemical treatment with sulphur dioxide is necessary to separate the hulls from the kernels. The basic equipment of a small-scale oil mill is a hammer-mill (coconut oil only), a screw press and a filter press. Only two or three persons are employed in the smallest units. In all cases the percentage yield of oil is higher in the large mills. The press cake remaining after the expulsion of the oil is a valuable animal feed.

(f) Laundry soap. Toilet soaps generally are made in large undertakings, but laundry soap is made at all industrial levels. The small-scale enterprises frequently make it by the "semi-boiled" process. The product is inferior to soap made by the "full-boiled" method, but it is more economical to make and very little in the way of equipment is needed. The ingredients commonly used are tallow, or tallow mixed with coconut oil, caustic soda, sodium silicate, powdered laundry blue and a soap perfume. The investment per worker varies from $450 (4 employees) to $2,000 (8 employees). The major capital cost is the workshed.

(g) Knitted cottons. The customary procedure is for the firm to use imported yarn to produce knitted fabrics in tube form on a circular knitting machine. The fabric is washed, bleached and, sometimes, dyed on the premises. Units may contain any number of knitting machines, but three is probably the minimum. Very often such garments as tee-shirts, singlets and men's underwear are made up in the knitting mill. The investment per worker in factories engaged in knitting and making up ranges from $1,400 to $3,000. For three concerns the figures are $1,400 (52 employees), $2,000 (32 employees) and $3,000 (22 employees).

(h) Apparel. Such garments as shirts, pyjamas, bathing suits, trousers, pull-overs, sweaters, blouses and the like are made from knitted cottons, bleached, dyed or printed, and poplins similarly finished. The minimum level of employment is about 10 persons, but some employ over 400. The majority are in the range 20 to 40 workers. The investment is between $600 and $2,700 per person. Five firms each employing between 20 and 25 persons had an average investment of just under $1,000 per worker, and in five units each with 30 to 40 employees the equivalent figure was $1,250. The maximum investment per employee occurred in firms employing between 50 and 60 workers.

(i) Mattresses (interior spring). The making of interior spring mattresses is often combined with furniture making, but there are firms that specialize in this line. The minimum size of unit will employ about 18 persons, the investment per worker being around $3,000, but in some larger units it may fall to about $2,000. It is not usual for mattress makers to manufacture their own springs. Many of the mattresses on the market have patented springing arrangements, but where coiled springs are used they are sometimes made on the premises. It is not profitable to make springs in a small-scale unit unless the excess output can be sold to other mattress manufacturers, or for upholstery.

(j) Metal furniture. Firms may specialize in office furniture - desks, chairs, filing cabinets - or household furniture - chairs, high-chairs, stools occasional tables and dinette sets. For office use, the pedestals for desks, and drawers for filing cabinets and desks are formed by folding and bending sheet steel, and the frames for chairs are made by bending imported square section tube. Seat cushions are of foam, plastic or natural rubber. The backs are of wood, padded and covered with polyvinyl sheet. A domestic chair usually consists of a chrome plated, or oxidized, frame of parallel or tapered steel tube supporting a cardboard or particle board seat on which a foam cushion is fitted. The back-rest is made of three-ply or solid wood,

shaped and padded. The material used to cover the seat and back-rest is polyvinyl sheet. Table tops are made of particle board or blockboard covered with a plastic laminate. Some manufacturers purchase the tubes already bent to shape, pierced and plated. Others buy the parallel tube in straight lengths to cut and bend. Plating is carried out by established electroplating firms. The tapered tubes are always bought with the ends drawn down to the desired size. The investment per worker ranges from about $3,100 (34 employees) to around $7,000 (25 employees).

(k) Wooden furniture. In many, but not all, countries factories making domestic furniture are found at all industrial levels. The present tendency appears to be for the larger units to produce standard designs, and for the lesser units to combine the production of household and institutional furniture with building fixtures. The very small concerns generally make furniture to order. The woodworking machinery employed is not highly specialized. A firm could switch from making furniture to the production of crates for beer or fruit without great difficulty. The average investment per worker taken over five establishments worked out at $3,200 and varied from $1,600 (43 workers) to $6,200 (10 workers).

(l) Converted paper products. Paper of the requisite quality is purchased for conversion into a wide range of products: toilet tissue, paper napkins, sanitary pads, paper bags (single-wall type), envelopes, exercise books, writing pads, paper plates, drinking cups, food containers, drinking straws and egg cartons. In the following table an approximation of the level of employment and investment per employee is given.

Product	Employment Range	Investment Per Worker (U.S. dollars)	Method
Toilet tissue, paper napkins, sanitary pads, paper bags, envelopes	10 - 45	2,600	Cutting, or cutting folding and gumming
Exercise books, writing pads, loose-leaf note-books	15 - 20	12,500	Cutting, ruling punching and binding
Paper plates, sanitary cups, food containers	about 10	4,000	Press moulding
Egg cartons	7 - 10	3,000	Press moulding
Drinking straws	about 5	1,500	Spiral winding

(m) Printing. In the small-scale sector most printers are engaged in jobbing. Some produce almanacs and calendars as regular lines to supplement their jobbing trade, and, if so, the art work is usually purchased from specialist colour printers. The employment may be at any level. The smallest has only a platten press, a guillotine, perhaps, a stitcher and three or four employees. The investment per worker is around $3,000. There is a tendency for investments to increase in this trade as the hand-fed platten press is replaced by the automatically-fed machine.

(n) Tanning. Tanneries can be divided into two main groups; those that produce only sole leather and those that produce sole and uppers leather. There is a subsidiary group that specializes in tanning goat, sheep and exotic skins. The volume of business is in bovine sole and uppers leather. For the production of sole leather only relatively simple equipment is necessary. The tanning materials can, in many instances, be obtained locally - mangrove bark, oak gall nuts, quebracho - and accurate chemical control, while desirable, is not as essential as in the chrome tanning process

used for uppers leather. As the vegetable tanning process may take as long as six months to produce a satisfactory tanned hide, the greater part of the investment, exclusive of cost of building, is in materials in progress. For the tanning and finishing of uppers leather an extensive range of machinery is needed, and there must be accurate and continuous control of the strengths and pH values of the reagents. A tannery producing sole and uppers leathers might employ about 50 workers at an investment of $6,000 per employee. Sole leather is made in one factory employing 8 persons, and the investment is about $7,000 per employee. The quantity and particularly the quality of locally arising hides have an important bearing on the success of the operation. If the quantity is deficient it is possible to import salted hides, but if the quality is low on account of wounds or badly flayed hides there will be great difficulty in disposing of the leather. Often the first step in improving the quality of local leather must be taken in the local abattoir.

(c) Fired clay products. The products are plain and glazed roof and floor tiles, bricks, hollow-blocks, soil and sub-soil pipes and sanitary wares. At cottage industry and slightly higher levels, plain roof and floor tiles and bricks are made by hand moulding. If any mechanical equipment at all is used it will be a manually operated press for repressing partially dried green bricks. At more advanced levels tiles are formed by machine pressing extruded clots of clay, and bricks, hollow-blocks and pipes are produced by extrusion. A vertical extruder is necessary for the making of pipes. For firing the Scotch kiln, usually wood fired, is used in the small-scale sector. Larger producers may use the down-draught or tunnel kiln, depending on whether their operations are conducted on a batch or continuous production basis. The quality of the available clay will determine the products to be made. All of those mentioned above, except sanitary wares, are made from common "red burning" clays. Refractory bricks are made from "buff burning" clays. Clays for whitewares, from soft glazed earthenware through "china" and stonewares to hard glazed porcelain require some form of benefication treatment. A feasibility study of a project to press roofing tiles in Turkey indicated that an investment of $198,800 was needed, and that about 80 persons would be employed. The high level of employment is due to the proposal to haul manually

the clay to the factory, and to transfer and stack the green tiles by hand. The investment per worker in units producing hollow blocks is between $5,000 and $7,000. The minimum size of establishment would have about 30 workers. Roof and floor tiles could be made with an investment around $3,000 per employee, using the minimum of power-driven machinery, and employing about 12 persons.

(p) Grey iron foundry. To support a foundry there must be a concentration of manufacturing establishments in the surrounding area, as a large part of the business will be the replacement of worn-out and damaged castings. It is possible, even usual, to combine with jobbing a number of stock lines - cooking pots, charcoal heated domestic irons, cable junction boxes, lavatory cisterns or special fittings for water mains. Some small foundries make rainwater ware, but this is better left to large units with specialized equipment. Foundries are found at all industrial levels. The smallest known to the writer employs only three persons, and consists of a single cupola, improvised out of oil drums, an electrically driven blower, and a few cast iron copes. Medium-sized foundries are usually equipped with two cupolas, blowers, overhead lifting gear, a core oven, screw tilting ladles and, if repetition work is carried on, one or two plate moulding machines. More advanced establishments will have in addition sand treatment plant, knock-out grills and possibly sand blasting plant. In most jobbing foundries the bottom on "drag" half of the mould is made in the floor sand, the "cope" or upper half being rammed in a steel or wooden box (flask). Such a foundry might produce about 5 tons of casting each week, and employ 10 to 15 workers. Where continuous casting is carried on, both halves of the flask are mounted on a plate conveyor which carries the mould to the pouring station, for an output of about 80 tons per week about 45 persons would be employed. An AID estimate of the investment per worker for a foundry employing around 30 persons is of about $5,000.

(q) Non-ferrous foundry. There is a large demand for non-ferrous castings, principally in brass and bronze, usually in the forms of valve bodies and lids, faucets, fittings for electrical appliances, gas stoves and cisterns, lock parts and water pump impellers. Alluminium castings are used for cooking

utensils, electrical appliances and machine parts. In a very small foundry the metals are likely to be melted in an oil or coke fired crucible furnace, and usually the greater part of the charge is scrap. For a foundry undertaking the casting of regular lines two tilting furnaces, one or more plate moulding machines, a core oven, a tumbling barrel and polishing heads would be required. To produce about 300,000 lbs. of castings per annum the investment would be of the order of $120,000 and the investment per employee about $7,000. Foundries with less capital equipment operate on an investment rate of about $5,000 per worker. A side-line that conveniently can be combined with any foundry is the remetalling of bearing shells; for automobile bearings small centrifugal casting machines are available.

(r) Metal pressings. The range of articles which are made by the cold pressing of such sheet metals as steel, brass and aluminium is enormous both in variety and physical size. It is obviously impossible to list more than a few of the commoner items; metal containers, crown tops, spoons, forks, drawer pulls, cooking utensils, sinks, refrigerator bodies, automobile panels, and so on. Establishments engaged in turning out metal pressings are found at all levels. The smallest may have two or three manually-operated presses, while the largest units have batteries of power presses of all sizes up to one thousand tons capacity. The small undertakings make physically small articles only; the big firms often are concerned with only large pressings. Irrespective of the size of the establishment the output in each style must be numerically great. The cost of a die set to make even a small part is considerable, and to form some types of article two or three sets of dies are needed. For example, the cost of the die set to form the metal strip of the clip used to hold papers in a file is about $1,200, while the clip sells for less than one per cent. Unless long production runs are possible it is impossible to recover the cost of the tools. In the small-scale sector the most likely products are small shallow metal containers (for instance, boxes for shoe polish, typewriter ribbon, etc.), eyelets for shoes and handbags, file clips, metal buttons, buckles, switch boxes, electrical parts, spoons, forks, ash trays, drawer pulls and metal trays. All of these can be made on a single acting eccentric press. Crown tops are used in vast quantities where there are established brewing and

aerated water industries. Sometimes this is one of the first articles to be pressed, however, unless lithographed tinplate strip is available it is not suitable for the small-scale undertaking. The investment per worker for the production of the articles listed immediately above is about $8,000. An average small press shop would employ about 20 persons.

(s) Fluorescent light fittings. These fittings are used in domestic, commercial and public buildings. This form of lighting is becoming increasingly popular. The establishments making these fittings produce the body by cutting, bending (or folding) and welding plain mild steel or galvanized iron sheet. Small metal parts are made on a nibbler or small power press. The transparent covers are moulded from acrylic sheet. The ballast condenser and lamp sockets are purchased from specialist firms. The basic equipment consists of a folding brake, a plate guillotine, a small press or nibbler, a spot welder, an oven for softening the plastic sheets and an improvised press for moulding them to the desired shape. The moulding dies are made of wood, and are inexpensive. The investment per employee is about $1,500 (20 employees).

(t) Television and radio assembly. In all cases in the television field, and in most cases in the radio field, the establishments are engaged in assembling branded products that formerly were imported in the built-up state. The operation is carried out either by a subsidiary of the manufacturer or under licence. The home demand and the possibilities for export to neighbouring territories will determine the scale of production. Specialized equipment is not necessary. Assembly is currently being carried on in establishments employing only 8 persons with an output of 4 sets per day. In larger units signal equipment may be installed to permit more comprehensive testing than can be done on the normal broadcasting channels. There is often a high import duty on imported receivers which, perhaps, explains the existence of the very small assembling units. While the assembly of television and radio receivers does reduce the element of imported labour in built-up sets, it may do so at a greater cost. The real advantage of assembly processes to an industrializing country is the opportunity gradually to replace imported components by locally made parts. In this industry there is seldom any saving in freight by importing components, and it is necessary

to carry fairly heavy stocks; most manufacturers only supply knocked-down packs in multiples of 200 sets. The investment is therefore heavier than one would expect from the simplicity of the operation. In the case of two firms, one employing 16 and the other 70 persons, investments are of around $3,500 per worker.

(u) Storage batteries. There is an increasing demand for accumulators for automobiles. There is a very considerable freight advantage in this industry, provided the entire battery is made in the country. Frequently this advantage is lost, or greatly reduced, by the necessity to import battery cases. An establishment often graduates into battery making from battery repairing. The basic process is casting the lead plate grids and cell connectors, filling the grids with lead oxide paste, joining like plates together to form a cell unit, inserting plate separators, placing the plate assemblies in the cells of the case and charging to "form" the positive and negative plates. Specialized equipment is necessary, and in respect of the plate grids it may be essential to carry a wide range of moulds. The investment per worker is in the range $7,000 to $8,000, and from 10 to 15 workers are employed.

(v) Plastic goods. During the last twenty years the use of plastic materials has increased almost beyond measure. Not only are the original plastic compounds still being used, but new uses are being found for them, and, in rapid sequence, new plastic materials with specialized properties are being made available. In almost every industry some particular plastic has succeeded in replacing a material formerly used. The production of plastic compounds and plastic material in sheet form is large-scale industry. At all industrial levels, with the possible exception of cottage undertakings, plastic compounds are moulded, or plastic sheets worked, into consumer goods. The range of articles manufactured runs from shirt buttons to automobile bodies. The many plastic materials in current use can be classified into three broad groups - thermoplastic, thermosetting and reinforced mouldings. A different production technique is needed for each group. The basic manufacturing methods are:

(i) For thermoplastic materials

(a) Injection moulding - The process is similar to metal die-casting, from which it was derived. The plastic crystals are fed into a heating chamber from which they are injected under pressure into a closed metal mould. Articles produced may vary in weight from a fraction of an ounce to around forty pounds. Injection moulding machines range from the manually operated type, in which a measured amount of material is inserted into the heating chamber by hand, and the injection pressure is applied by means of a lever and toggles, to automatic models which perform the entire cycle of operations and eject the completed articles. The type of goods produced includes bottle stoppers, pill boxes, combs, stop lights for automobiles, bowls, cups, saucers, spoons, drinking "glasses" and fancy goods generally. The plastic compounds selected will depend on the use to which the article will be put. In most cases the olefine, vinyl and cellulosic plastics will be used.

The cost of the moulds is high. It is necessary to be assured of reasonably long production runs before embarking on such a project. The capital investment is fairly high, an AID study quotes $183,000 or $11,440 per worker for 16 persons employed.

(b) Extrusion. In this process, the thermoplastic material is fed continuously by a rotating spiral which carries it through a heating chamber and forces it through a die. Tube, sheet, film and any continuous profile may be made in this way. It is also used for the covering of wire with insulating material. An operation, often carried out at small-scale level, is the making of polythene bags. An adaptation of the extrusion process is "blow moulding". An extruded tube, while it is still hot and pliable, is placed between two halves of a mould, and compressed air is injected to "blow up" the tube. Hollow containers from a few cubic centimetres to a capacity of 50 gallons can be made.

The investment required to make and print polythene bags (in rented premises) is approximately $35,000 or $1,750 per worker for about 20 persons employed.

(c) Sheet moulding. There are, at least, four variants - vacuum moulding, snap back moulding, plug-assisted moulding and blow-back moulding. In all of these a heated sheet of plastic material is forced to conform to the shape of a mould. As low moulding pressures are employed, it has the advantage that such inexpensive materials as wood or plaster may be used to make the moulds. The process is used by small-scale undertakings to produce bottles, containers and the transparent covers for lighting fixtures. In larger establishments linings for refrigerators are made on automatic machines.

(d) Slush moulding (Rotational moulding). Balls, toys and hollow bodies are made by this technique. A measured quantity of polythene or a polyvinyl chloride (P.V.C.) plastisol is placed in a heated cast aluminium or electro-formed copper mould. The mould is then rotated in two planes until the inside walls are evenly covered with the plastic compound. The installed cost of a rotational moulding machine capable of producing about 100 pieces per hour is around $3,600. The moulds are expensive; consequently long runs are essential.

(ii) For thermosetting materials.

Compression moulding. A predetermined amount of moulding powder is placed in the heated cavity of a mould. The mould is then closed and pressure is applied causing the powder to flow within and fill,the mould cavity. The plastic compounds principally used are from the phenoeic and amino groups. Among the articles commonly produced are the insulated parts in electrical fittings, cups, saucers, automobile rotors and distributor caps. The presses used are usually completely automatic, performing the whole cycle of operations except loading the powder into the mould. In most instances they are provided with their own hydraulic pumps. They are very costly and likely to be beyond the resources of small-scale industry. However the writer is aware of electrical fittings (the plastic parts of light and power plugs) being made by means of a fly-press; the mould being heated, as required, by a blow-lamp.

(iii) Reinforced mouldings.

Two methods are used in small-scale establishments: (a)"hand lay-up" and (b) "spray lay-up". In the former fibreglass is built up on a wooden or plaster mould, to the required thickness by bonding with epoxy or polyester resins. In the "spray lay-up" process a mixture of fibre-glass rovings, resins and a catalyst is sprayed on to the mould. Neither method is suitable for making very small objects, but there is virtually no limit to the upper size. Cafeteria stools, safety helmets, lamp shades, surf boards, speed-boat hulls, water tanks, water pipes, kitchen sinks and the like are made. Sometimes the hulls of wooden vessels are completely sheathed by the "spray lay-up" process to prevent marine worm attack. Very little in the way of equipment is required. Exclusive of a building the cost of a single spray-gun unit would be about $12,000. If working capital and inventory of materials are included the investment would be around $30,000, and would employ between 8 and 12 persons.

(iv) Cellular plastics.

Foamed or expanded plastics can be moulded in various ways. A common method makes use of "book form" moulds. The mould is pre-heated and the resin is poured into it. The resin expands to fill the mould, and after a curing period of a few minutes the mould may be opened and the article removed. If sheet is required the resin is metered on to a continuous length of release paper supported on a flat conveyor with flanged sides. The resin is allowed to expand freely forming a continuous slab. Foam mattresses and seat cushions are made by this process using urea plastics. Expanded polythene requires a slightly different technique. The pre-heated beads or crystals are placed in a closed mould and steam is introduced. Expansion of the beads takes place almost immediately. After cooling the moulding can be removed. Heat and acoustic insulating materials are made in this way. They may be moulded into such articles as picnic baskets, flower pots and ice buckets. For the manufacture of flexible foams an investment per worker is about $13,000 (12 persons) and for rigid expanded materials around $6,000 (20 employees).

(w) Wax candles. There are two types of candle, the cast and the dipped. The former is made by small and medium-scale undertaking, while the latter generally is made at cottage industry level. A machine to cast candles costs approximately $2,500, and can turn out about 500 dozen per eight-hour day. The total investment for a factory producing about 400,000 lbs. of wax candles per annum would be about $60,000 and would employ about 20 persons. Candles can be cast in a multiple core mould. In this case the wick has to be threaded through each core in the mould before casting. The cost of a mould is approximately $100. A small unit might have twelve moulds and employ 3 persons. Decorative and "giant" candles are cast in individual moulds, which may be improvised from tin-plate. The equipment needed to make dipped candles consists of a dipping frame, costing about $8.00 and a wax bath. The materials for lighting and decorative candles are paraffin wax and stearic acid. If church candles are to be made they must contain about 20 per cent beeswax.

(x) Jewellery. Such ornaments as earrings, wedding, engagement and signet rings, lockets and bracelets may be made by one or two craftsmen, by handicraft methods, working on their own behalf, but more often employed by a retail jewellery store. On the other hand a very much greater range of work is produced in factories employing between 20 and 30 persons. In the latter type of establishment there will be facilities for casting, rolling, wire drawing and stamping gold and silver, and for enamelling. Among the principal products are religious medallions and gold chain. The cost of the varied equipment may amount to $40,000 and the total investment to $100,000 (30 persons).

(y) Lumber Industries. Under this heading may be included all of the separate operations that transform a log into lumber. There are large and small-scale sawmills. Often a sawmill must be small on account of the limited offtake of timber permitted in an area. The girth of the available timber may affect the size of the unit. There is a tendancy for the smaller units to be located in the forest areas, and the larger units to be near to the centres of population density. In the past, a small sawmill was equipped with only one

or two hand-fed circular saws. The machines were, in fact, re-saws, and suitable for breaking down only small logs. Nowadays they are being replaced by hand-fed bandsaws, which although they allow faster cutting are not really suitable. It is only in the bigger units that the correct equipment is to be found - vertical or horizontal bandsaws with traversing tables. In such units it is usual also to produce dimensioned stock. An AID estimate of the investment needed to produce 4,000,000 board feet of rough lumber per annum is $101,000 (16 employees) $6,310 per worker). A similar investment would be required to turn out 750,000 board feet of planed dimensioned lumber.

Associated operations are kiln drying and pressure impregnation of lumber. The former is seldom carried out although kiln-dried lumber can command a small premium. It can be performed with improvised equipment at very little cost. Pressure impregnation is usually done in or near a lumber depot. The investment in a suitable plant may be about $90,000 (23 employees) (about $4,000 per worker).

(z) Mixing of animal and poultry feeds. An intensive poultry industry or large-scale animal husbandry is necessary to support this operation which is carried on at all levels. The investment may vary from $20,000 (12 employees) to $600,000 (100 employees). The smaller units usually purchase the trace components already mixed.

(aa) Black nuts and bolts. Nuts and bolts are usually made by mass-production methods. In countries where oil is produced or refined there may be sufficient demand to make manufacture by small-scale methods possible, provided that the unit can be set up in connexion with an existing machine-shop. It is doubtful if an independent unit would be viable. Bolts and nuts are made of mild and special steels. The type for which the market is likely to be large, and the most suitable for small-scale production, is the "black" mild steel bolt and nut. It is possible to effect economies by using scrap reinforcement rod in their manufacture. A small subsidiary plant would require an investment of about $30,000 (6 persons) ($5,000 per worker) to produce about 90,000 lbs. of black bolts and nuts per annum.

The possibility of starting an enterprise to manufacture any of the products listed above will depend on the particular circumstances currently affecting the inter-related factors of production. An operation that could not be entertained in a country that freely allows the entry of manufactured goods of foreign origin may be feasible in one where imports are restricted, or there is a substantial level of protection. The cost factors are likely to vary from country to country. The estimates given above, therefore, should be regarded as only first approximations.

III. INDUSTRIAL FIELDS IN WHICH THE SMALL-SCALE UNDERTAKING IS THE PREVALENT TYPE

It has been mentioned earlier that the small-scale establishment is well adapted to providing services directly to its customers, to fulfilling the needs of specialized markets, to sub-contracting and to the processing of certain agricultural crops. It will be appreciated that the small-scale undertaking does not have a monopoly in the above fields; exceptions will be obvious to everyone. It will be realized, also, that, except in connexion with the processing of crops, no clear-cut distinction can be made between them. Direct servicing, sub-contracting and supplying a specialized market can be, and often are, inter-related. For that reason, no attempt is made here to attribute the existence of an enterprise to any one of the four functions given above; a better indication of the opportunities available to the small-scale sector is given by consideration of what is being, or may be, done with the materials likely to be available. In what follows, the activities sometimes described as "service industries" - laundering, dry-cleaning, catering, personal services, automobile and household repairing, decorating and the like - are omitted.

Metalworking industries

(a) Metal spinning. This activity, which is virtually absent in many developing countries, can turn out simple and complicated hollow-wares in steel, copper, brass and aluminium. Most of the articles produced by this process also can be made by drawing and pressing. The expensive dies necessary

in the latter method are not required in spinning; it is, therefore, well adapted to short production runs. Specially designed spinning machines are available. However, the operation can be performed satisfactorily on an ordinary lathe. Basins, bowls, vases, indeed any hollow-ware of circular or elliptical section can be spun. A profitable line is the making of trophy cups. Small dished ends for pressure vessels are sometimes made. The investment in a plant with spinning lathes, employing 4 persons is estimated by AID at about $22,000. The writer is aware of a small unit, in Turkey, where 3 ordinary lathes produced three 24 centimetre copper basins every two minutes. The investment per worker was less than $1,000.

(b) Sheet-metal work. There is a great variety of goods that can be formed from sheet-metal by folding and rolling. Small establishments, using in the main galvanized iron, produce buckets, pails, rice cookers, dippers, guttering and flashings. All of these can be made without the use of power-operated equipment. The increasing popularity of air conditioning is creating a demand for ducting in light gauge metal, the meeting of which is a profitable field for the non-specialist sheet-metal shop. Another line is the making of equipment for the feeding and watering of poultry. A small unit could be started, in rented premises, with about $3,000 capital. It would provide employment for 3 or 4 persons.

Specialist sheet-metal shops may produce automobile mufflers and radiators. There is a good market for both of these items as replacements. If cars and trucks are assembled in the country, these, usually, are among the first locally manufactured components to be incorporated. Mufflers can be made for the repair trade by the use of only hand-operated tools. This is not possible, however, if the requirements of the vehicle assembly industry are to be met. Highly specialized equipment is necessary for the manufacture of radiators. Some firms find it profitable to undertake only the building up of radiator cores. In such cases the finned, flat tube elements are imported, and the investment is reduced by the cost of tube forming and tinning equipment. The investment per worker in a unit to produce mufflers and exhaust pipes, depending on the extent of tooling, may vary from $2,500 (15 persons) to about $6,000 for twenty. A factory to repair and manufacture radiator cores and tanks will require an

investment of the order of $10,000 (18 persons) per worker. Other common lines in the sheet-metal trade are aluminium advertising signs, numerals and number plates for automobiles, and metal labels.

(c) Tools and dies. Dies are used by the pressed metal and plastics industries. Some of the large concerns in these fields maintain their own tool and die shops. The usual practice, however, is to purchase their requirements from specialist firms. A survey made in the Caracas area disclosed 18 such establishments with a total employment of 111 die makers, excluding apprentices; four were one-man concerns, and six employed between 9 and 13 persons. The smaller shops were each equipped with a power hacksaw, a sensitive vertical drill, a lathe, a horizontal shaper and an electric muffle furnace. Larger units had in addition to the foregoing a pantographic milling machine, a filing machine and improvised means of surface grinding. Most of the establishments undertook the making of jigs and fixtures, although none had facilities for jig-boring. Tool and die making requires a very high degree of skill. While it is possible to recruit experienced die makers, it is not a branch of the metal working industry that should be considered by entrepreneurs without practical experience. The minimum investment needed to set up a one-man shop is around $8,000, exclusive of premises.

(d) Wirework. Under this heading are included wire nails, fencing of various kinds and articles made of wire. Wire nails are usually made by medium-size firms using the same methods as the small-scale producers. Unless mild steel wire is produced in the country, it is inadvisable to attempt the manufacture of nails. There is very little freight differential between nails in casks and coiled wire. The investment needed to produce 10 tons of nails per day is approximately $65,000 (20 persons). Galvanized and chain link fencing do not require a great deal of capital for their manufacture, often the machinery is locally made. The only unit of which the writer is aware that manufacturing chain link fencing exclusively employs only two workers and turns out 40 yards per day. Among the articles made from wire that offer opportunities to the small-scale sector are paper clips, bird cages, rat traps and hair pins.

(e) Farm hand implements. The range of farm hand implements is too great for all of them to be manufactured by a small-scale undertaking. It is advisable to concentrate on one or two of the most commonly used tools - mattocks, machettes or digging spades. A very small unit, really a blacksmith's shop could undertake to make mattocks and machettes by hand forging. Both investment and output would be very low. Such units are useful as they can make use of scrap material that arises locally. A larger unit would employ either forging machines and power presses or a hydraulic hammer and power presses. The investment is likely to be of the order of $8,000 per worker, with a minimum of about 20 workers.

(f) Jobbing machine shop. The type of undertaking should be one that could carry out machinery repairs and build small agricultural and other machines. It should be equipped to undertake turning, drilling, shaping and welding at least. In most cases it would be advisable to have plate rolling, and universal milling equipment. The investment will depend on the extent of the equipment, but will be between $5,000 and $8,000 per worker.

(g) Ornamental ironwork. Workshops engaged in this branch of the trade make window grills, gates, fences, balcony railings and, sometimes, staircases to customers' orders. In addition, they may produce garden furniture as a standard line. The basic equipment is a set of hand-operated rolls, a tube and bar bender and welding and cutting appliances. A unit might employ 10 persons with an investment of $1,500 per worker. In more sophisticated plants the investment per worker might be as high as $5,000.

Woodworking industries

(a) Wood parquetry. The use of hardwood parquetry flooring is increasing. It possesses excellent wearing, insulating and decorative properties. The main uses are likely to be found in public buildings and medium to high price housing. There are good prospects for export. The manufacture of parquetry is a profitable operation where there is a supply of kiln-dried lumber, as the "raw" material is, in the main, offcuts and scrap which otherwise would be useless except as fuel. The investment in a plant to manufacture [illegible] would be about $150,000 (15 employees).

(b) Emballage. In spite of the increasing use of cardboard containers there is still a very good demand for wooden crates for fruit and beverages. In some cases fruit for export must be shipped in wooden crates. The local deliveries from breweries and aerated water factories are almost always made in wooden boxes. The size of a plant to produce the shooks for fruit crates will depend on the quantity of fruit arising. In some countries practically all of the producers are equipped with only a bandsaw on which they breakdown the logs and cut the boards to size. This represents the minimum size of plant and it is not to be recommended for in many cases the boards are too rough and fruit may be damaged. A well equipped small unit should contain a resaw, bandsaw and planer. About 5 men would be employed and the investment per employee would be about $6,000. For beverage boxes it would be necessary to add a groover, notcher and a hand-hole cutting machine. The investment per worker would be about the same.

(c) Wood moulding. One of the principal uses of wood mouldings is to cover the joints in cellotex ceilings. In any town of over 500,000 inhabitants there is likely to be enough demand to support a small shop. The equipment consists of a circular saw, overhand planer, a "French" vertical spindle and a belt sander. Very often bench type appliances can be used. The cost of equipment should not exceed $1,200. The same plant can be used to make beadings for furniture. A side line might be the production of brush and broom handles, which often can be cut from side flitches which otherwise would be useless. For this a miller and a sanding machine would be required.

(d) Wood turning. The furniture trade uses large numbers of taper turned legs for occasional tables. The cotton spinning industry consumes immense quantities of bobbins, and where weaving is carried out there may be a demand for wooden shuttles. All that is required to make table legs is a wood-turning lathe, preferably with a taper turning attachment. This machine would also make bobbins and shuttles, but a small hand press would be needed to form the metal ends of the bobbins, and an end miller to cut out the chases in the shuttles. The minimum size of a unit would probably employ 5 persons.

(e) Ice cream spoons, etc. Articles made from veneers such as ice-cream spoons, popsicle sticks, tooth picks and paint stirrers may be in demand. To produce them from logs would necessitate equipment to make veneers. It is estimated by A.I.D. that a plant to produce these items from the log would require an investment of $99,000 and employ 14 persons. It is suggested that where veneers are cut for the furniture trade, it would be profitable to purchase these and to carry out only the stamping and sanding operations.

(f) Flush doors. The manufacture of flush doors may be undertaken by large and medium-sized woodworking plants as one of their standard lines, or by small joiners' shops on a jobbing basis. However, in a populour area where there is an extended rehousing programme, there should be sufficient work to support a small specialized unit. An outlet for flush doors is to be found, also, in the shipbuilding industry. Such a unit could operate on an initial investment of $60,000 and provide employment for 10 persons.

(g) Footwear. Rough wooden slippers, consisting of a crudely shaped sole and toe-strap of leather or rubber, have been made for generations at cottage industry level. There is currently a demand for what is basically the same article, but in a highly finished form. The equipment required to make these consists of a band-saw and a sander. If there is a well established leather footwear industry there will be a demand for boot and shoe lasts. Lasts are now made on specialized copying lathes which are very expensive machines. The minimum investment in a last plant would be about $200,000.

Glass products

(a) Glass ornaments. Hand-blown glassware in the form of bowls, vases or jardinieres, particularly in attractive colours, appears to sell very well, and there may be a good export market. It would be necessary to have supplies of iron-free raw materials, sand, feldspar and limestone. The melting is carried out in small "pot" furnaces which are usually oil fired. No equipment other than iron blow pipes and glass blowers' benches are required to form the articles. It is necessary, however, to provide means of annealing, a lehr or an oil fired oven, and for grinding the bases. A small unit might consist of six persons and involve an investment of around $36,000.

(b) Glass scientific apparatus. The making of scientific apparatus and pharmaceutical appliances from purchased glass tubing is carried out by small undertakings. Such apparatus as pipettes, burettes, measuring jars and ampoules frequently are made. A small establishment might consist of six workers. Little in the way of equipment is needed - an air compresser, a source of town or bottled gas, some burners and a means of lapping glass cocks. An A.I.D. study estimates the required investment at $224,000 (22 workers), however, there must be many concerns operating at an investment per worker of around $5,000.

(c) Laminated safety glass. The manufacture of flat laminated safety glass can be carried out at any industrial level, but it is usually undertaken by large concerns. However the making of the curved or "wrap round" automobile windshields is a small-scale operation in those countries without an automobile industry. The basic process is the joining of two sheets of ordinary plate glas by means of non-brittle plastic film under moderate heat and pressure, and subsequently annealing in an autoclave under pressure. To make the "wrap round" windshield, a skeleton metal frame of the required shape is built, and the sandwich of glass and plastic (film or crystals) is placed on the frame and heated in an oven to such temperature that the glass becomes flexible and conforms to the skeletal shape. On cooling the sandwich is passed through rubber covered rollers to press together the layers, and then annealed as for flat laminated glass. The investment will be of the order of $40,000 and six or eight men would be employed.

(d) Mirrors. Mirrors are used in every home, and there is a need for re-silvering facilities. It is customary for a unit catering to this demand to make frameless mirrors, and to undertake re-silvering. In some cases the bevelling of mirrors may also be carried out. It is essential that an ample supply of water is available. An establishment in which only silvering and re-silvering is done would require an investment of about $28,000 and employ 5 persons (A.I.D.). A factory that also undertook to grind, polish and bevel the glass might need a capital of $100,000 and give work to 15 persons.

Leather work. Included in this term are artificial leathers (plastics). In natural leather such articles as wallets, pocket books, spectable cases, brief cases and school bags are made. The trade is really an extension of sadlery. The only machines involved may be for power stitching and buffing. To a very great extent such plastic materials as vinyl-coated fabrics have replaced leather for all of the above items and particularly for ladies handbags and shoes. There is likely to be sufficient demand to support the manufacture of plastic handbags and ladies shoes. A factory turning out some 100 dozen handbags per week using imported frames had an investment of $85,000 and 20 employees. A shoe factory producing one line of ladies flat heeled shoes at the rate of 500 dozen pairs per month had the same investment and number of employees.

Rubber based industries

(a) Camelback. In countries producing rubber it is usual to make camelback from ribbed smoked sheet (R.S.S.). The R.S.S. is passed through a two-roller mill and the compounding chemicals are added. When these are thoroughly mixed and the whole reduced to the correct plasticity the material is removed from the rollers. It is then fed into an extruder which is provided with a die of the desired dimensions. A ribbon of camelback emerges which is cut into convenient lengths. A plant of this type would cost about $100,000 (6 persons). In smaller units the extruder is not used. The camelback is milled to the required thickness and is cut in the desired width directly from the rolls. There is considerable heat generated in the milling operation so that it is necessary to water cool the rolls. In not a few instances the mills are converted crepe rubber masticators. In such a case the investment would not exceed $12,000 (2 set rolls, 3 employees).

Where rubber is not produced locally and the number of vehicles is not very high, say of the order of 50,000, prepared camelback slabs are imported. These are vitually in the same state as they were when removed from the compounding mill. The slabs are fed into an extruder from which camelback of the required section emerges as before.

(b) Rubber mouldings. The manufacture of rubber mouldings is very often combined with the production of camelback. For constant profile mouldings such as windshield wipers, automobile door and windshield sealings it is necessary only to change the extruder die. In the oil fields there is a very good demand for soft rubber mouldings for pump glands, pipe joints and the like. These, of course, must be formed in separate moulds, but the moulds are of ordinary mild steel and not particularly expensive to make. A unit producing camelback from imported slab and soft rubber moulding would require an investment of $50,000 and employ 10 persons.

(c) Tyre recapping. All tyre recapping shops have the following equipment in common; tyre spreader, tyre buffing machine, boiler, air compressor, vulcanizers and vulcanizer matrices. The size of the shop depends on the number of vulcanizers. It is doubtful if a unit would be viable with less than 3 vulcanizers and a range of matrices for truck and automobile treads. A shop to recap some 5,000 automobile and 4,000 truck tyres would require an investment of $51,000 and employ 16 persons (A.I.D.).

(d) Rubber slippers. Rubber soled footwear, consisting of a flat sole and a moulded rubber ankle thong, are easily made on much the same equipment as is used to produce camelback on a small scale. In addition to two compounding rolls a press with steam heated platens is needed. The plasticized, compounded rubber is placed in the cavities of a shaped mould to produce the thongs, and in a flat mould to produce the vulcanized sheet from which the soles are cut. In very small units the profiles of the soles are cut by hand, but in larger units a clicking press may be used.

(e) Dipped rubber goods. Such articles as rubber kitchen gloves and balloons are made by dipping patterns in latex to which ammonia, colouring materials and extenders have been added. The patterns can be made of wood or aluminium. The wall thickness of the goods being made is controlled by the number of dippings made. A very simple article to make is a toy balloon. The pattern is only a number (24 - 60) of pencil-like sticks vertically secured to a board. The rest of the equipment consists of three or four dipping tanks, storage racks and, if coloured balloons are made, a small ball mill. One such unit in Indonesia employs 25 persons, mostly young persons, and produces 10,000 balloons per day. The investment, apart from the work shed, is very small indeed.

Cement based industries

(a) Ready-mixed concrete. The supply of ready-mixed concrete takes two forms:

(i) The cement, sand and aggregate are discharged in the required proportions, into a mixing truck where the water is added. The concrete is delivered on site ready for placing. The investment is considerable as it is necessary to operate a small fleet of mixing trucks, which are expensive. The investment per employee varies with the size, $4,340 (100 employees), $5,300 (51 employees) and $10,800 (32 employees).

(ii) The cement and sand are mixed and bagged. The aggregate and water are added on the site. A much smaller investment is required; a unit, in rented premises, has a capital of $20,000 and employs 11 persons.

(b) Concrete blocks. Precast concrete blocks for buildings are made by numerous firms varying in size from 4 to 75 persons. Associated lines are concrete curbings, paving blocks and garden ornaments. The investment per employee lies around $2,200, but there are cases where it is as high as $6,500 (75 employees) and as low as $1,500 (40 employees).

(c) Concrete tiles. Flooring tiles made from pressed sand/cement mixtures come in several forms; plain or coloured, polished or unpolished, and, with the addition of marble chips (Terrazzo). The plain or coloured unpolished tile requires only a manual or hydraulic press, a pair of moulds and curing racks for its manufacture. A two-man team can make about 400 tiles per day. The cost of a manual press is about $5,000. To make polished tiles wet surface grinding equipment is needed. In not a few instances this is improvised. Where Terrazzo tiles are made it is usual to undertake the construction of Terrazzo floors and wall coverings. An automatic tile press and accessories might cost as much as $25,000 and 12 - 15 men might be needed to feed and handle its output.

(d) Pozzolanic concretes. In some countries there may be supplies of pozzolanic materials - porcellanite, volcanic ash, pumices, tuffs - that are not cementitious in themselves, but which become so upon admixture with hydrated lime. These materials finely ground are sometimes mixed with Portland cement to improve the quality, particularly if the cement is to be used for mortars. In Indonesia, building blocks are cast using a cement of four parts volcanic ash and one part lime.

(e) Concrete pipes. Pipes and culverts are best made by spinning which is usually a medium to large scale operation. However there are many small firms making pipes by the hand ramming of pre-mixed concrete in metal moulds. The basic equipment is a cement mixer and a series of moulds. In the smaller units pipe making is often carried out in conjunction with the casting of concrete sinks and sanitary fittings.

Agricultural products and by-products

(a) Coconuts. The principal material obtained from the coconut is edible oil. There are also valuable by-products - coir fibre and kernel meal or flour. The fibres from the coconut husk may be extracted by manual or mechanical means. The simplest method is to soak the husks in brackish water from four to six months and then to separate the fibres from the corky matter by beating with a wooden club. After drying the fibres are spun by hand or by simple hand operated machine, into yarn. This method is possible only if labour costs are very low. It is improbable that outside of India and Ceylon this is a profitable operation. The yarn commands the highest price ($590 per ton) of any of the grades of coir. Machines can be obtained to crush retted husks and to separate the fibres, in some models the fibres are sorted into bristle and mattress grades.

Bristle fibre can be extracted from retted husks by a ginning process. Two machines are used, a breaker and a cleaner. These machines require about 10 HP and cost in the neighbourhood of $4,500. Two men could handle about 2,000 husks per eight-hour day. This would result in about 220 pounds of bristle fibre and 450 pounds of mattress fibre. Bristle fetches approximately $280 per ton and mattress fibre $98 per ton.

In larger installations no attempt may be made to separate the grades of fibre. The unretted husks are fed into a hammer mill or rotary beater and through a screen or screens to remove the corky matter (or bass) and pieces of kernel. The fibre is dried, then baled under hydraulic pressure, and sold as mattress fibre. There is very little labour employed in this operation and the cost of the machinery is high, as is the power to operate (75 - 100 HP and over).

The coir yarn may be spun into ropes, plaited or woven. Coir ropes are descreasing in popularity as synthetic fibres become available. Plaiting may be done by hand or machine and the plaits built up into rugs and mats. Sacking may be made on hand looms, one eaver can produce about 24 feet of sacking per day, or into carpets. Stair and hall carpets, commonly called coconut matting are machine woven. Carpets, however, are often hand woven by knotting tufts of coir into cotton warping.

The bristle fibres are used for brushes of various types including paint brushes. The fibre has a natural "flag" which holds the paint. Very often the brisle fibres are dyed before use, perhaps to simulate hog bristle.

As its name suggests mattress fibre is used for stuffing mattresses and upholstery. However, nowadays the fibre may be machine felted into mats or pads which are used to cover the internal springs in mattresses and chairs. A further use is in the making of rubberized coir. The fibre is spun into loose "curls" or ropes which are coated with latex and vulcanized. The "curl" is thus permanently fixed and a strong springey material results. Coir pads and curls are likely to be the most profitable fields where labour costs are high.

The ground kernel of the coconut is used as a filler in the production of certain classes of plastic goods. A recently discovered use is as a component in the filtering media in oil wells.

(b) Cassava. Manioc or cassava is grown as a food crop in most Latin American countries and in the Far East. Certain varieties of the tubers may be eaten raw or boiled, sliced and sundried, or, and this includes all varieties, converted into flours. In Latin America, they are usually made into "farine", a coarse flour, or into "couac", a bread-like material. Both of these have the advantage of keeping almost indefinitely.

The preparation of farine or couac is a cottage industry. As foods they are declining in popularity. There appears to be reasonably good prospects for tapioca. It is, however, as a source of starch for human and animal consumption and for industrial purposes that the greatest promise is held for cassava. To produce a refined starch suitable for compounding with cereal flours in the manufacture of biscuits, or for use in the textile and paper industries, the minimum viable size of plant is about 5 tons per 24-hour day. This would involve an investment of around $400,000 and give employment to 30, or so, persons. A unit to produce a somewhat less refined flour, suitable as the basis of animal and poultry feeds and for conversion into tapioca, at the rate of one ton per day, would need an investment in the vicinity of $55,000 to provide work for 7 persons.

At cottage industry level there are possibilities of making sauces from the liquid expelled when the grated cassava is pressed, an essential stage in the making of farine. This liquid is in fact the basis of the old West Indian "Pepperpot" and also "Worcester" sauce.

(c) Sorghum (Sorghum vulgare). This cereal crop is grown in hot climates all over the world, and is known by such varied names as Egyptian corn, millet, koaliang and petit mil. It is used in the ground form as a meal from which porridges and cakes are made, or as a poultry feed. Sometimes it is converted into "popcorn". These are commonplace uses wherever it is grown. The flowering heads, after the removal of the grain, are sometimes known as broomcorn, which, as its name implies, can be used to make whisk brooms. A plant to manufacture these brooms would require an investment of about $12,500 and would employ 8 - 10 persons. The production capacity would be of the order of 9,000 dozen per annum.

(d) Bananas and plantains. Both bananas (Musa paradisiaca) and plantains (Musa sapientum) contain useful fibres in their stems. During the Japanese occupation of Malaya sacks were made from these fibres. Some experimental work has been done in making sugar sacks in Cuba. In Travancore the fibres are used for cloth and cordage. In Trinidad, in cottage establishments, the fibres are woven into a cloth that is used to make handbags. Fibre from the leaf sheath of Musa chinensis can be used to make oil-press cloths. Although fibres from bananas and plantains are considered to be only slightly inferior to abaca they are not used to any great extent on account of the high cost of extraction. Where bananas are grown on a plantation scale mechnanical decorticators might prove profitable, and the cut stems would certainly provide material for hand stripping at cottage industry level. Potato crisps are popular snacks in most countries. Similar crisps can be made from green plantains. Some small concerns make these crisps by slicing the plantains on an attachment to a household mincing machine and, after drying, fry them in a cage in deep fat. The equipment to make them on a small commercial scale costs about $5,200.

(e) Limes. Lime oil is used extensively in the manufacture of food products, confectionery, perfumes and toilet preparations. The best quality, known as "eculled oil" is produced by rolling the fresh fruit around in a shallow copper bowl studded with large blunt nails. Various machines - presses, extruders, raspers - have been developed to simulate this process, but all of them require the application of water which results in an emulsion from which the oil must be separated. The oil may be obtained also by steam distillation of the rinds. The distilled oil commands a substantially lower price than the "eculled oil".

Miscellaneous forest and vegetal products

The products listed below are, with the exception of pineapple, uncultivated. In the main they are fibre crops which, in most cases, are used in handicrafts as supplies are limited to natural stands, and often suitable machinery is not available. Such materials as sisal, kenaf, sunn hemp, jute and ramie which are cultivated on a plantation scale do not offer any opportunities for small-scale enterprise.

(a) Bamboo. Bamboo is pulped for paper in large scale plants. In small units making wrapping paper from repulped waste paper, rice straw and other miscellaneous fibres, the addition of bamboo fibre will greatly increase the strength of the product. The main uses, however, of bamboo at the small-scale level are likely to be the manufacture of articles from split cane and souvenirs. From the split cane can be made baskets, sun blinds, matting and parasol frames. There are usually ample supplies of bamboo available to support production on a factory scale. The Japanese have developed a range of suitable machines for splitting, rolling, polishing and weaving bamboo.

(b) Terite. (Ischnosiphon arouma). The long slender stems of this plant can be used for making fine basketwork.

(c) Manac (Euterpe broadwayana). From the flower sheath and the leaf petioles of this palm a brush fibre may be obtained, which has excellent resistance to water. So far as the writer is aware no special machinery has been developed to extract the fibre, but it is believed that any decorticating machine with a beating action could be used.

(d) Cocorite (Maximiliana caribaea). This palm flourishes on sandy and gravelly soils, and on barren hillsides. A brush fibre is obtained from the leaf petioles.

(e) Screw pine (Pandanaceae). The ribbons obtained from this plant are used in plaited form to make mats, handbags and baskets.

(f) Vegetable tannins. The bark of the mangrove (avicennia spp.) and the peds of Divi-Divi (Caesalpinia coriaria) can be used for the tanning of sole leathers. The bark is disintegrated by a hammer-mill and the tannin is leached out with hot water. In some cases this is done directly in the tanneries. However small undertakings sometimes are set up to produce concentrated extracts. The process is one of repeated boiling until a solid material is formed.

(g) Khus-khus grass (Vetiveria Zizanordes). This is a coarse grass much used, on account of its dense mass of fibrous roots, for binding earthworks. From the roots a perfume can be extracted, and from the blades very attractive floor mats are made.

(h) Tapia (Sporobotus indicus). Sometimes known as wire grass, lizard grass or mulatto plait. It is used for fodder, for stuffing mattresses, and is the principal fibre used in making tapia plastering for houses. It can also be used for making small whisk brooms.

(i) Pineapple. In the Philippines and China (Taiwan), the fibre extracted from the leaves of the pineapple are made into a fine cloth (Pina in the Philippines). The leaves are stripped by hand in these countries, but experiments in Kenya suggest that the machinery used to decorticate sisal can be used. There are possibilities of pulping the leaves for use in paper manufacture.

(j) Rice straw. A coarse, not particularly strong, wrapping paper can be made from rice straw. The process is very simple. The straw is "cooked" in a solution of lime, washed and passed through a "hollander" or even a domestic meat mincer. The pulp or stock is kept agitated in a vat from which it is discharged in regulated amounts on to the gauze band of an improvised Fourdrinier table. The felt is then passed through rollers on to zinc sheets on which it is dried. The quality of the product could be greatly improved by the admixture of other fibres such as bamboo, sisal, cotton, and the like.

Miscellaneous products

The following products do not fit into any of the groups heretofore listed in this section:

(a) Mosquito coils. The coils are made by extruding a mixture of pyrethrum, potassium nitrate, a bonding agent and a filler. Ground coconut kernel flour could be used as a filler. Sometimes additional insecticides and perfumes are added. The investment per worker is about $2,500 per person (12 - 20 employees).

(b) Pomades, etc. Hair creams and the like are made by the addition of various colouring and aromatic agents to petrolatum waxes and emulsions. The equipment consists of stainless steel tanks and stirrers. A small unit might involve an investment of $30,000. Some toilet preparations in this class are now aerosol packed, and where this is done an investment of about $70,000 (12 persons) is needed.

(c) Liquid bleach. There is a very good demand for liquid bleach for household and laundry use. The usual method of manufacture is to pass chlorine through a solution of caustic soda. The investment in a plant to produce 87,000 gallons per annum is $85,000 (12 persons).

(d) Zip fasterners. Zip-fasteners at one time were used only for ladies dresses. Now the use has extended to men's clothing, handbags, suitcases and even footwear. The manufacturing operation requires a fairly heavy investment in machinery; between $50,000 (468,000 dozen fasteners per annum) and $64,000 (670,000 dozen per annum). The employment varying between 22 and 36 workers. This industry has to face heavy competition from Japan and central European countries in the low price field.

(e) Polishes. Shoe and floor polishes consist basically of a mixture of various types of waxes to which colouring and, in the case of floor polish, perfume are added. Many of the furniture and automobile polishes now contain polythene wax and silicones. Frequently these are aerosol packed. The investment in a plant producing only shoe and floor polishes might be about $15,000 (10 employees) and in one producing shoe, floor, furniture, automobile and glass polishes about $60,000 would be needed (18 persons).

CONCLUDING REMARKS

The manufacture of the foregoing products may provide opportunities for small-scale enterprise. The list is by no means complete. Indeed, in a paper of this length it would be impossible to include all of them. Much valuable information on suitable products and the equipment required to manufacture them can be obtained from the publication of the Indian Central Small Industries Organisation.5/

It is hoped that it has been shown that the small-scale undertaking is a permanent feature of the industrial scene; that it is able to adjust itself to ever changing conditions and to seize opportunities as they arise; that it offers great scope for specialized operations and customer service; that it can and should be "modern".

In an address to a group of large foundry operators in the United States, one of the most efficient large producers of machined castings said (and I can only quote approximately): "We boast of our management sophistication in using Professor Juran's 'Universals of Management', particularly in restricting our major selling efforts and production to those relatively few customers who can provide about 90 per cent of our business, but the real and rather chastening reason why we cannot sell and produce profitably in the shorter-run products is that the small producers can beat us on price, quality and delivery nearly every time. Using a lot of hand labour with readily modified tooling, and serving their customers through their ingenuity rather than through the capital used, they run rings around us with our long change-over times and high overheads".6/

5/ Government of India, Ministry of Industry, Central Small Industries Organisation, Model Schemes (about 200 pamphlets); Analysis and Planning Reports (about 150 pamphlets); Towards Better Technique (about 200 pamphlets Impact Programme Schemes (about 150 pamphlets); Choose Your Small Industry (August 1965).

6/ Extract from Trinidad and Tobago Productivity News, Port-of-Spain.